

In general a fiducial marker on the catheter allows the preoperative scan and the real time scans to be appropriately merged. In operation the user can define a location on the MSS workstation 300 with a mouse or other pointing device which identifies the desired location of the therapy. Next the MSS workstation computes the forces and required fields and gradients required to navigate the catheter to the new location. this information controls the magnet system 308. An appropriate set of catheter actuators 306 may be provided to allow the MSS to move the catheter as well.

What is Claimed Is;

- 10 1. A catheter for treating an occluded vessel comprising:
  - a catheter body having a proximal end and a distal end, said distal end terminating in a distal tip;
  - an energy source coupled to said distal tip for supplying energy to the distal tip for treating an occlusion;
  - 15 a magnetically active element located proximate said distal tip responsive to externally applied magnetic fields whereby said externally applied magnetic fields direct and orient said distal tip.
2. The catheter of claim 1 wherein said magnetically active element forms at least a portion of said distal tip.
- 20 3. The catheter of claim 1 further including a lumen positioned in said catheter body extending from said proximal end to said distal end.
4. The catheter of claim 1 further including one or more electrical coils located proximate said distal tip for cooperation with a localization device.

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5. A sheath for use with a catheter of claim 1 for treating a vessel occlusion comprising:

a sheath body having a proximal end and having a distal end;

a lumen extending from said proximal end to said distal end;

5 a magnetically active element located proximate said distal tip.

6. A system for treating a vessel occlusion comprising:

a sheath, having a sheath body, said sheath body having a proximal end and having a distal end;

10 a lumen extending through said sheath body from said proximal end to said distal end;

a catheter having a catheter body having a proximal end and a distal end terminating in distal tip;

an energy source coupled to said distal tip;

a magnetically active element located proximate said distal tip of said catheter body.

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7. A system for treating a vessel occlusion comprising:

a sheath, having a sheath body, said sheath body having a proximal end and having a distal end;

a lumen extending through said sheath body from said proximal end to said distal end;

20 a catheter having a catheter body having a proximal end and a distal end;

an energy source coupled to said distal tip for delivering therapeutic energy to a vessel occlusion;

a magnetically active element forming a portion of said distal tip of said sheath body.

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8. The catheter of claim 1 including a first metallic element located proximate said distal tip adapted for coupling to a remote radio frequency energy source whereby RF energy coupled to said metallic element heats said metallic element.

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9 The catheter of claim 8 wherein said metallic element forms one pole of a monopolar energy distribution system.

10. The catheter of claim 9 further comprising a second metallic element proximate said distal tip forming a pole of a bipolar energy distribution system.

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11. The catheter of claim 1 including a thermally conductive element located proximate said distal tip adapted for coupling to a remote optical laser energy source whereby optical energy coupled to said thermally conductive element heats said thermally conductive element.

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12. The catheter of claim 11 wherein said thermally conductive element is metallic.

13. The catheter of claim 1 further including an ultrasonic waveguide element located proximate said distal tip adapted for coupling to a remote ultrasonic frequency energy source.

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14 The catheter of claim 1 further including a resistance heating element located proximate said distal tip adapted for coupling to a remote electrical energy source.

15. The catheter of claim 14 further including a resistance heating element located proximate said distal tip adapted for coupling to a remote AC electrical energy source.

5 16 The catheter of claim 14 further including a resistance heating element located proximate said distal tip adapted for coupling to a remote DC electrical energy source.

17. The catheter of claim 1 further including a fluid directing element located proximate said distal tip adapted for coupling to a remote hydraulic energy source, whereby fluid  
10 coupled to said device extracts occlusive material from locations near the distal tip.

18. The catheter of claim 3 further including a laser imaging device located in said lumen for observing an occlusion.

15 19. The catheter of claim 3 further including a ultrasonic imaging device located in said lumen for observing an occlusion.

20 . A system for treating total occlusions of a patient's vasculature comprising:

a catheter having an elongate body and a distal tip;

20 a heated element located proximate the distal tip of the catheter;

a magnetic element located proximate the distal tip;

a magnetic surgery system for interacting with said magnetic element;

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said magnetic surgery system including a localization device to determine the location of the catheter distal tip within the body;

said magnetic surgery system including an occlusion visualization device for presenting an image to a user which depicts the location of the catheter tip.

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21 The system of claim 20 wherein said visualization device is an ultrasonic imaging wire.

22. The system of claim 20 wherein said visualization device is a laser imaging wire.

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23. A system for treating total occlusions of a patient's vasculature comprising:

a catheter having an elongate body and a distal tip;

a heated element located proximate the distal tip of the catheter;

a magnetic element located proximate the distal tip;

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a magnetic surgery system for interacting with said magnetic element;

said magnetic surgery system including a localization device to determine the location of the catheter distal tip within the body;

said magnetic surgery system including a catheter location visualization device for presenting an image to a user which depicts the location of the catheter tip.

20 24 The system of claim 23 wherein said catheter location visualization device is a preoperative CT image.



25. The system of claim 23 wherein said catheter location visualization device is a preoperative MRI image .

26. A method of treating a total vascular occlusion comprising the steps of:

- 5        inserting a catheter having a magnetic tip into the body;  
      directing the catheter to the location of the total occlusion;  
      imaging the catheter tip to confirm and direct therapy;  
      energizing said catheter to heat said distal tip;  
      manipulating said distal tip by the application of external magnetic fields , directing said  
10       catheter tip into said occlusion.